

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
8 February 2001 (08.02.2001)

PCT

(10) International Publication Number  
**WO 01/09143 A1**

(51) International Patent Classification<sup>7</sup>: C07D 501/34

(21) International Application Number: PCT/IB00/01024

(22) International Filing Date: 24 July 2000 (24.07.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
1036/Del/99 30 July 1999 (30.07.1999) IN

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(81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:

- With international search report.
- Before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments.

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: AN IMPROVED AMORPHOUS FORM OF CEFPODOXIME PROXETIL

(57) Abstract: A novel process for the production of an improved amorphous form of cefpodoxime proxetil [(6R-[6 $\alpha$ , 7 $\beta$  (Z)]-7-{E(2-Amino-4-thiazolyl) (methoxy-imino)acetyl]amino]-3-(methoxymethyl)-8-oxo-5-thia-1-azabicyclo [4.2.0] oct-2-ene-2-carboxylic acid-1-[(1-methylethoxy) carboxylic acid-1-[(1-methylethoxy)carbonyl]oxy]ethyl ester, is described.

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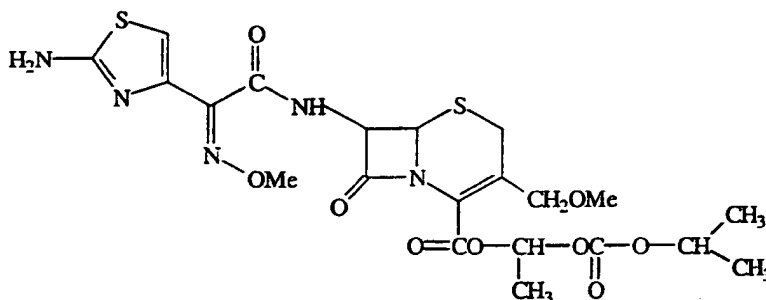
# AN IMPROVED AMORPHOUS FORM OF CEFPODOXIME PROXETIL

## FIELD OF THE INVENTION

5 This invention relates to an improved amorphous form of cefpodoxime proxetil and a novel process for the production thereof.

## BACKGROUND OF THE INVENTION

Chemically, cefpodoxime proxetil is [(6R-[6 $\alpha$ , 7 $\beta$  (Z))]-7-{E(2-Amino-4-thiazolyl) (methoxyimino)acetyl]amino]-3-(methoxymethyl)-8-oxo-5-thia-1-aza-  
10 bicyclo [4.2.0] oct-2-ene-2-carboxylic acid-1-[[[(1-methylethoxy) carboxylic acid-1-[[[(1-methylethoxy)carbonyl]oxy]ethyl ester having the following formula



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## FORMULA I

and is covered in U.S. Patent No. 4,486,425. Cefpodoxime Proxetil is a valuable antibiotic characterized by high broad spectrum activity against

gram-positive and gram-negative micro-organisms. It has also been found to be highly active against susceptible and resistant strains of *N. gonorrhoeae*.

The latest trend in the pharmaceutical industry is to study polymorphism in drugs as well as the difference in the activity of different polymorphic forms of a given drug. The term polymorphism includes different physical forms, crystal forms, crystalline/liquid crystalline/non-crystalline (amorphous) forms. This has become very interesting especially after observing that many antibiotics, antibacterials, tranquilizers etc., exhibit polymorphism and one or more of the polymorphic forms of a given drug exhibit superior bio-availability and consequently show much higher activity compared to other polymorphs. It has also been disclosed that the amorphous forms in a number of drugs exhibit different dissolution characteristics and in some cases different bioavailability patterns compared to the crystalline form [Konne T., Chem. Pharm. Bull., 38, 2003 (1990)]. For some therapeutic indications one bioavailability pattern may be favored over another. Sertraline, Frenitizole, Sulphathiazole, Indomethacine etc. are some of the important examples of pharmaceuticals which exhibit polymorphism. A host of patents have been granted pertaining to these drugs. To cite a few, U.S. Patent No. 5,248,699 discusses about five polymorphic forms of sertraline hydrochloride while EP 014590 describes four polymorphic forms of Frenitizole. EP 490648 and EP 022527 also deal with the subject of polymorphism in drugs.

Since cefpodoxime proxetil is poorly absorbed from the gastrointestinal tract, it is therefore present in sera and urine only in low

concentrations after oral administration. Accordingly, there has been a need for a form of cefpodoxime proxetil which has better intrinsic dissolution and is capable of being better absorbed from the gastro-intestinal tract following oral administration.

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### SUMMARY OF THE INVENTION

In accordance with the first aspect of the present invention, an efficient method is provided for the preparation of an amorphous form of cefpodoxime proxetil which has better intrinsic dissolution when compared with that of cefpodoxime proxetil prepared by conventional solvent precipitation.

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The second aspect of the present invention provides a process for the preparation of cefpodoxime proxetil in an amorphous form which comprises dissolving cefpodoxime proxetil prepared by the conventional solvent precipitation in a suitable solvent followed by recovering amorphous form of cefpodoxime proxetil from the solution thereof by spray drying, wherein the amorphous form has a better intrinsic dissolution rate than cefpodoxime proxetil prepared by conventional solvent precipitation.

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The term "suitable solvent" is selected from the group consisting of ketones, alcohols, esters, chlorinated solvents, ethers, acetonitrile and mixtures thereof. Preferably, the solvent is selected from the group consisting of acetone, methanol, ethanol ethylacetate, chloroform, dichloromethane, tetrahydrofuran, 1,4-dioxan and mixtures thereof.

In accordance with the present invention cefpodoxime proxetil is recovered from the solution in an amorphous form using a spray drying technique. The Mini-Spray-Dryer (Model : Buchi 190, Switzerland) which is used, operates on the principle of nozzle spraying in parallel-flow i.e. the sprayed product and the drying gas flow in the same direction. The drying gas can be air or inert gases such as nitrogen, argon, and carbon dioxide. Nitrogen is preferred in this case.

#### BRIEF DESCRIPTION OF DRAWINGS

Figure 1 shows the infra-red spectrum of the amorphous cefpodoxime proxetil prepared according to the process of the present invention.

Figure 2 shows the X-ray powder diffraction pattern which demonstrates the amorphous nature of the cefpodoxime proxetil prepared according to the present invention.

#### OBJECTS OF THE INVENTION

The first object of the invention is to prepare a pharmaceutical composition comprising cefpodoxime proxetil in an amorphous form that has a better intrinsic dissolution rate than that of cefpodoxime proxetil prepared by the chemical method alone.

The second object of the invention is to develop a process for the preparation of cefpodoxime proxetil in an amorphous form which comprises dissolving cefpodoxime proxetil prepared by the conventional solvent precipi-

tation method in a suitable solvent and recovering an amorphous form of cefpodoxime proxetil from said solution by a spray drying technique wherein the amorphous form has a better intrinsic dissolution rate than that of cefpodoxime proxetil prepared by the conventional solvent precipitation method alone.

### DETAILED DESCRIPTION OF THE INVENTION

The present invention is illustrated by the following examples which are not intended to limit the effective scope of the claims:

#### **EXAMPLE 1**

Cefpodoxime Proxetil (100gm) was dissolved in acetone (770ml) at 25-30°C. The clear solution so obtained was subjected to spray drying in a mini-spray dryer (Buchi model 190) at an inlet temperature of 75°C and outlet temperature of 55°C with a feed rate of 15ml per minute. Cefpodoxime proxetil (80gm) in an amorphous form was thus isolated.

Infrared spectrum in KBr (Figure 1), and X-ray powder diffraction pattern (Figure 2), as shown in the accompanying drawings, confirmed the amorphous nature of the product.

#### **EXAMPLE 2**

Cefpodoxime Proxetil (100gm) was dissolved in methanol (600ml) at 25-30°C. The clear solution so obtained was subjected to spray drying in a mini-spray dryer (Buchi Model 190) at an inlet temperature of 75°C and outlet

temperature of 58°C with a feed rate of 15ml per minute. Cefpodoxime proxetil (83gm) in an amorphous form was thus isolated.

Infrared spectrum in KBr and X-ray diffraction pattern confirmed the amorphous nature of the product.

- 5            While the present invention has been described in terms of its specific embodiments, certain modifications and equivalents will be apparent to those skilled in the art and are intended to be included within the scope of the present invention.

**CLAIMS**

1. Cefpodoxime proxetil in an amorphous form which is prepared by a process that comprises dissolving cefpodoxime proxetil prepared by conventional solvent precipitation in a suitable solvent and recovering an amorphous form of cefpodoxime proxetil from the solution by a spray drying technique wherein the amorphous form has a better intrinsic dissolution rate than that of cefpodoxime proxetil prepared by the chemical method alone.
2. The process of claim 1 wherein the suitable solvent is selected from the group consisting of ketones, alcohols, esters, chlorinated solvents, ethers, acetonitrile and mixtures thereof.
3. The process of claim 2 wherein the solvent is selected from the group consisting of acetone, methanol, ethanol, ethylacetate, chloroform, dichloromethane, tetrahydrofuran, 1,4-dioxane and mixtures thereof.
4. The process of claim 3 wherein the solvent is selected from the group consisting of acetone, methanol or ethanol and mixtures thereof.
5. The process for the preparation of amorphous cefpodoxime proxetil that comprises dissolving cefpodoxime proxetil prepared by the conventional solvent precipitation method in a suitable solvent and recovering amorphous form of cefpodoxime proxetil from the said solution by a spray drying technique wherein the amorphous form has

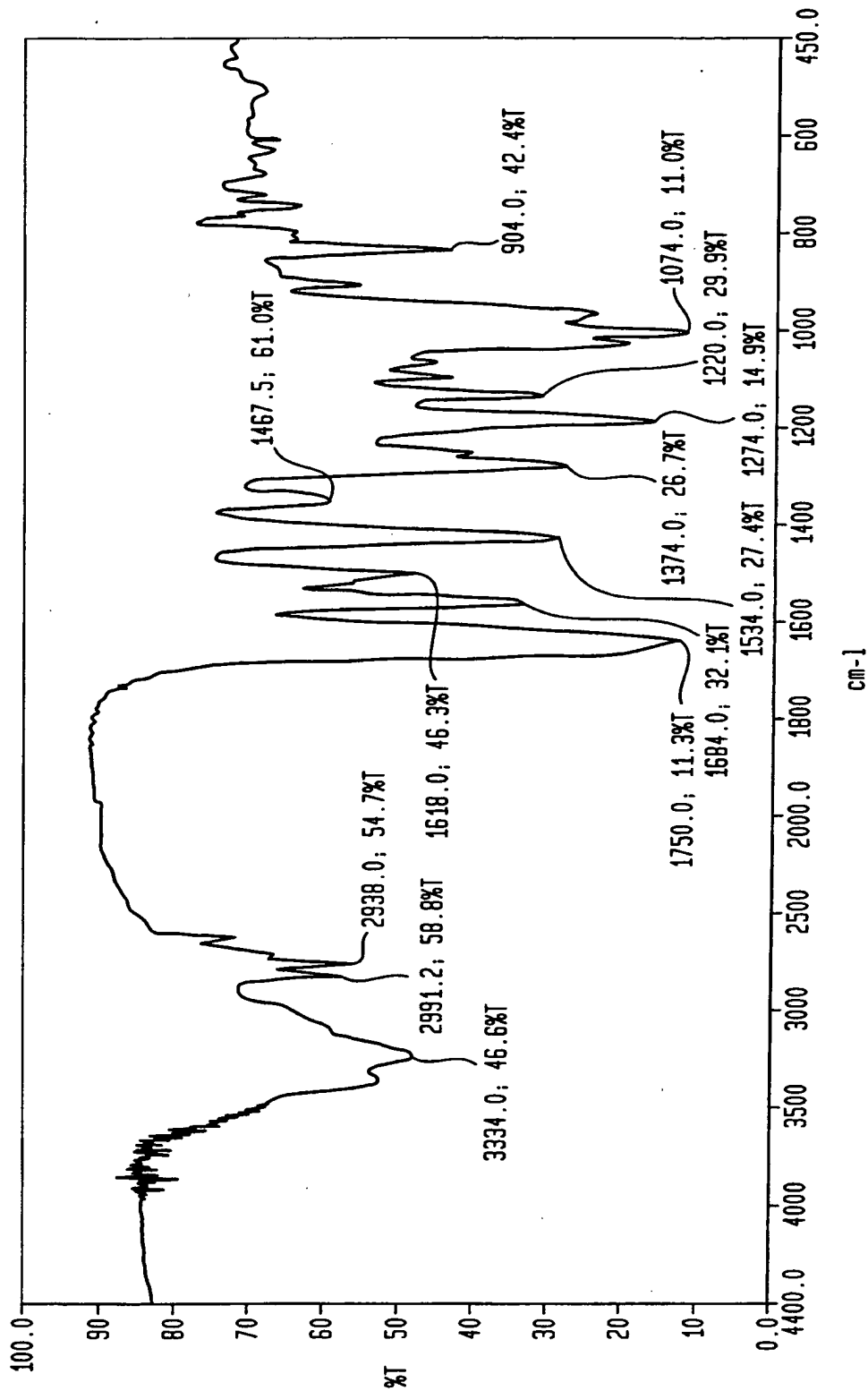


a better intrinsic dissolution rate than that of cefpodoxime proxetil prepared by the conventional solvent precipitation method alone.

6. The process of claim 5 wherein the suitable solvent is selected from the group consisting of ketones, alcohols, esters, chlorinated solvents, ethers, acetonitrile and mixtures thereof.
7. The process of claim 6 wherein the solvent is selected from the group consisting of acetone, methanol, ethanol, ethylacetate, chloroform, dichloromethane, tetrahydrofuran, 1,4-dioxane and mixtures thereof.
8. The process of claim 7 wherein the solvent is selected from the group consisting of acetone, methanol or ethanol and mixtures thereof.

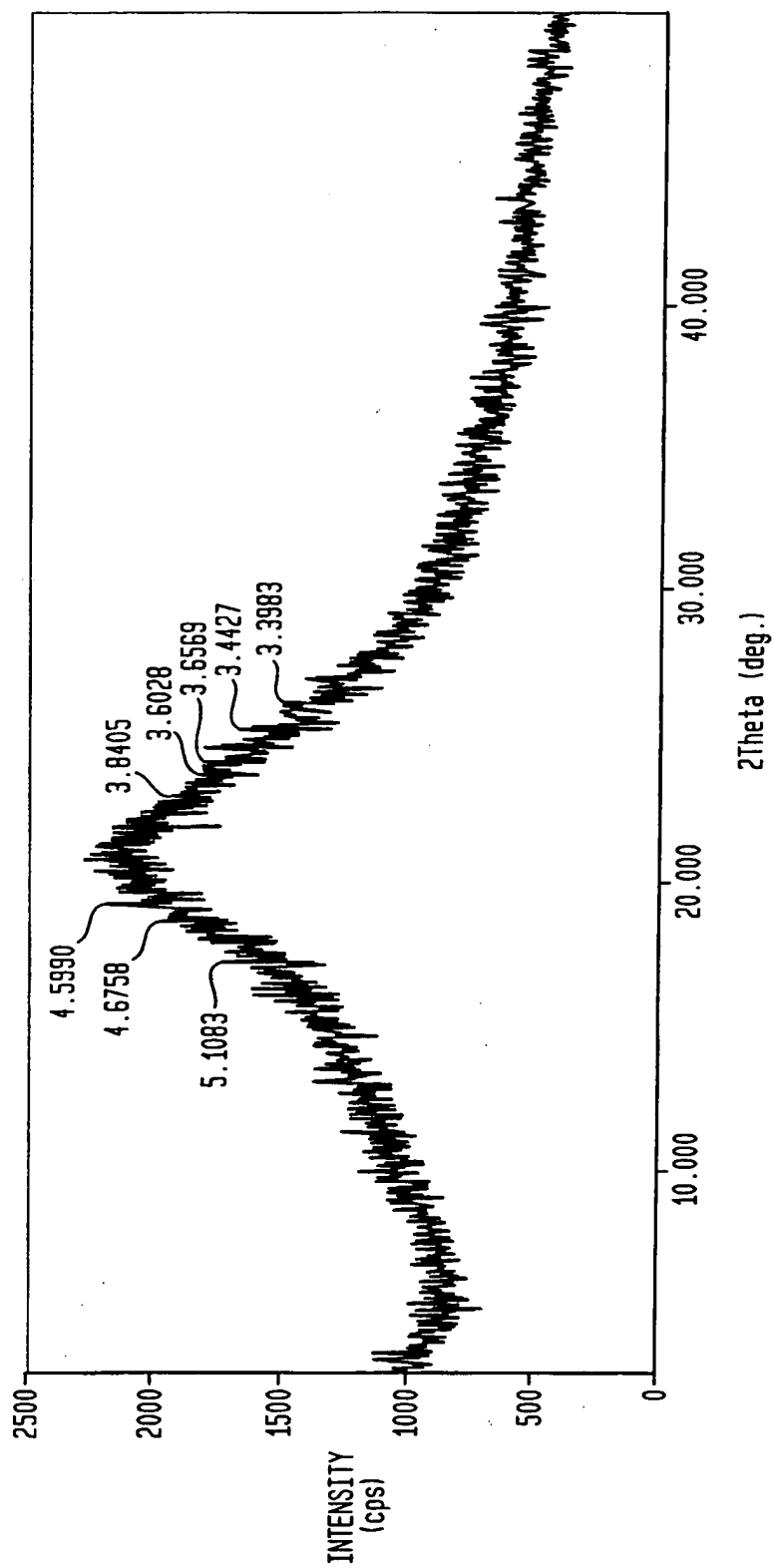
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FIG. 1



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FIG. 2



# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/IB00/01024

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :C07D 501/34

US CL :540/228

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 540/228

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CAS Online

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4,486,425 A (NAKAO et al.) 04 December 1984, see Abstract.	1-8
A	US 4,562,181 A (CRISP et al.) 31 December 1985, see Abstract.	1-8
A, E	US 6,107,290 A (WOO et al.) 22 August 2000, see Abstract.	1-8

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier document published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&" document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means	
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search

21 NOVEMBER 2000

Date of mailing of the international search report

09 JAN 2001

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